## Chapter 13: Statistics and 14: Probability
## Exercise : 13.1

**Question 1: In the formula $\bar{x}$ = a + $\frac{\sum f_i d_i}{\sum f_i}$, for finding the mean of grouped data $d_i$'s are deviation from *a* of**
**(a) lower limits of the classes (b) upper limits of the classes**
**(c) mid-points of the classes (d) frequencies of the class marks**
**Solution: (c)** We know that, $d_i = x_i - a$
i.e., **$d_i$'s** are the deviation from a of mid-points of the classes.

**Question 2: While computing mean of grouped data, we assume that the frequencies are**
**(a) evenly distributed over all the classes**
**(b) centred at the class marks of the classes**
**(c) centred at the upper limits of the classes**
**(d) centred at the lower limits of the classes**
**Solution:**
**(b)** In computing the mean of grouped data, the frequencies are centred at the class marks of the classes.

**Question 3: If $x_i$'s are the mid-points of the class intervals of grouped data, $f_i$'s are the corresponding frequencies and $\bar{x}$ is the mean, then $\sum(f_i x_i - \bar{x})$ is equal to**
**(a) 0 (b) -1 (c) 1 (d) 2**
**Solution:**
$\bar{x} = \frac{\sum f_i x_i}{n}$
therefore, $\sum(f_i x_i - \bar{x}) = \sum f_i x_i - \sum \bar{x}$ = n$\bar{x}$ - n$\bar{x}$ = 0

**Question 4: In the formula $\bar{x}$ = a + h$\left(\frac{\sum f_i u_i}{\sum f_i}\right)$, for finding the mean of grouped frequency distribution $u_i$ is equal to**
**(a)** $\frac{x_i+a}{h}$ (b) b($x_i$ – a) (c)$\frac{x_i-a}{h}$ (d) $\frac{a-x_i}{h}$

**Solution**: (c)
Given, $\bar{x}$ = a + $\left(\frac{\sum f_i u_i}{\sum f_i}\right)$
Above formula is a step deviation formula, $u_i = \frac{x_i-a}{h}$

**Question 5: The abscissa of the point of intersection of the less than type and of the more than type cumulative frequency curves of a grouped data gives its**
**(a) mean (b) median (c) mode (d) All of these**
**Solution:**
(b) Since, the intersection point of less than ogive and more than ogive gives the median on the abscissa.

**Question 6: For the following distribution,**

| **Class** | **0 – 5** | **5 – 10** | **10 – 15** | **15 – 20** | **20 – 25** |
|---|---|---|---|---|---|
| **Frequency** | **10** | **15** | **12** | **20** | **9** |

**the sum of lower limits of the median class and modal class is**
**(a) 15** **(b) 25** **(c) 30** **(d) 35**

Solution: (b)

| Class | Frequency | Cumulative frequency |
|---|---|---|
| 0 – 5 | 10 | 10 |
| 5 – 10 | 15 | 25 |
| 10 – 15 | 12 | 37 |
| 15 – 20 | 20 | 57 |
| 20 – 25 | 9 | 66 |

Now, $\frac{N}{2} = \frac{66}{2}$ = 33, which lies in the interval 10-15. Therefore, lower limit of the median class is 10.
The highest frequency is 20, which lies in the interval 15-20. Therefore, lower limit of modal class is 15. Hence, required sum is 10 + 15 = 25.

**Question 7: Consider the following frequency distribution**

| **Class** | **0 – 5** | **6 – 11** | **12 – 17** | **18 – 23** | **24 – 29** |
|---|---|---|---|---|---|
| **Frequency** | **13** | **10** | **15** | **8** | **11** |

**The upper limit of the median class is**
**(a) 7** **(b) 17.5** **(c) 18** **(d) 18.5**

**Solution:** (b)

| Class | Frequency | Cumulative frequency |
|---|---|---|
| -0.5 – 5.5 | 13 | 13 |
| 5.5 – 11.5 | 10 | 23 |
| 11.5 – 17.5 | 15 | 38 |
| 17.5 – 23.5 | 8 | 46 |
| 23.5 – 29.5 | 11 | 57 |

**Question 8: For the following distribution,**

| Marks | Number of students |
|---|---|
| Below 10 | 3 |
| Below 20 | 12 |
| Below 30 | 27 |
| Below 40 | 57 |
| Below 50 | 75 |
| Below 60 | 80 |

**the modal class is**
**(a) 10-20** **(b) 20-30** **(c) 30-40** **(d) 30-40**
**Solution**: (c)

| Marks | No. of frequency | Cumulative Frequency |
|---|---|---|
| Below 10 | 3 = 3 | 3 |
| 10 – 20 | 12 – 3 = 9 | 12 |

| | | |
|---|---|---|
| 20 – 30 | 27 – 12 = 15 | 27 |
| 30 – 40 | 57 – 27 = 30 | 57 |
| 40 – 50 | 75 – 57 = 18 | 75 |
| 50 – 60 | 80 – 75 = 5 | 80 |

Here,we see that the highest frequency is 30. which lies in the interval 30-40.

**Question 9:**
**Consider the data.**

| Class | 65-85 | 85-105 | 105-125 | 125-145 | 145-165 | 165-185 | 185-205 |
|---|---|---|---|---|---|---|---|
| Frequency | 4 | 5 | 13 | 20 | 14 | 7 | 4 |

**The difference of the upper limit of the median class and the lower limit of the modal class is**
**(a) 0** **(b) 19** **(c) 20** **(d) 38**
**Solution:** (c)

| Class | Frequency | Cumulative frequency |
|---|---|---|
| 65 – 85 | 4 | 4 |
| 85 – 105 | 5 | 9 |
| 105 – 125 | 13 | 22 |
| 125 – 145 | 20 | 42 |
| 145 – 165 | 14 | 56 |
| 165 – 185 | 7 | 63 |
| 185 – 205 | 4 | 67 |

Here, $\frac{N}{2} = \frac{67}{2}$= 33.5 which lies in the interval 125 -145.
Hence, upper limit of median class is 145.

Here, we see that the highest frequency is 20 which lies in 125-145. Hence, the lower limit of modal class is 125.
Required difference = Upper limit of median class – Lower limit of modal class
= 145-125 = 20

**Question 10:**
**The times (in seconds) taken by 150 atheletes to run a 110 m hurdle race are tabulated below**

| Class | 13.8-14 | 14-14.2 | 14.2-14.4 | 14.4-14.6 | 14.6-14.8 | 14.8-15 |
|---|---|---|---|---|---|---|
| Frequency | 2 | 4 | 5 | 71 | 48 | 20 |

**The number of atheletes who completed the race in less than 14.6 s is**
**(a) 11** **(b) 71** **(c) 82** **(d) 130**
**Solution: (c)** The number of atheletes who completed the race in less than 14.6
= 2 + 4+ 5+71 =82

**Question 11:**
**Consider the following distribution**

| Marks obtained | Number of students |
|---|---|
| More than or equal to 0 | 63 |
| More than or equal to 10 | 58 |
| More than or equal to 20 | 55 |
| More than or equal to 30 | 51 |
| More than or equal to 40 | 48 |
| More than or equal to 50 | 42 |

**the frequency of the class 30-40 is**
**(a) 3** **(b) 4** **(c) 3** **(d)** 4
**Solution:** (a)

| Marks obtained | No. of students |
|---|---|
| 0 – 10 | 63 – 58 = 5 |
| 10 – 20 | 58 – 55 = 3 |
| 20 – 30 | 55 – 51 = 4 |
| 30 – 40 | 51 – 48 = 3 |
| 40 – 50 | 48 – 42 = 6 |
| 50 – … | 42 = 42 |

Hence, frequency in the class interval 30-40 is 3

**Question 12:**
**If an event cannot occur, then its probability is**
**(a) 1** **(b) $\frac{3}{4}$** **(c) $\frac{3}{4}$** **(d) 0**
**Solution:**
**(d)** The event which cannot occur is said to be impossible event and probability of impossible event is zero.

**Question 13:**
Which of the following cannot be the probability of an event?
(a) $\frac{1}{2}$ (b) 0.1 (c) 3 (d) $\frac{17}{16}$
**Solution:**
**(d)** Since, probability of an event always lies between 0 and 1.

**Question 14:**
**An event is very unlikely to happen. Its probability is closest to**
**(a) 0.0001** **(b) 0.001** **(c) 0.01** **(d) 0.1**
**Solution:**
**(a)** The probability of an event which is very unlikely to happen is closest to zero and from the given options 0.0001 is closest to zero.

**Question 15:**
**If the probability of an event is P, then the probability of its completmentry event will be**

**(a) P -1** **(b) P** **(c) 1 – P** **(d) 1—$\frac{1}{P}$**

**Solution:**

**(c)** Since, probability of an event + probability of its complementry event = 1
So, probability of its complementry event = 1 – Probability of an event = 1 – P

**Question 16:**

**The probability expressed as a percentage of a particular occurrence can never be**

**(a) less than 100** **(b) less than 0**
**(c) greater than 1** **(d) anything but a whole number**

**Solution:**

**(b)** We know that, the probability expressed as a percentage always lie between 0 and 100. So, it cannot be less than 0.

**Question 17:**

**If P (A) denotes the probability of an event A, then**

**(a) P(A) < 0** **(b) P(A) > 1** **(c) 0 ≤ P(A) ≤ 1** **(d) -1 ≤ P(A) ≤ 1**

**Solution:**

**(c)** Since, probability of an event always lies between 0 and 1.

**Question 18:**

**If a card is selected from a deck of 52 cards, then the probability of its being a red face card is**

(a) $\frac{3}{26}$ (b) $\frac{3}{13}$ (c) $\frac{2}{13}$ (d) $\frac{1}{2}$

**Solution:**

(c) In a deck of 52 cards, there are 12 face cards i.e.,6 red and 6 black cards.
So, probability of getting a red face card = $\frac{6}{52}$ = $\frac{3}{26}$

**Question 19:**

**The probability that a non-leap your selected at random will contains 53 Sunday is** ‘

**(a)** $\frac{1}{7}$ **(b)** $\frac{2}{7}$ **(c)** $\frac{3}{7}$ **(d)** $\frac{5}{7}$

**Solution:**

**(a)** A non-leap year has 365 days and therefore 52 weeks and 1 day. This 1 day may be Sunday or Monday or Tuesday or Wednesday or Thursday or Friday or Saturday. Thus, out of 7 possibilities, 1 favourable event is the event that the one day is Sunday.
∴ Required probability = $\frac{1}{7}$

**Question 20:**

**When a die is thrown, the probability of getting an odd number less than 3 is ,**

**(a)** $\frac{1}{6}$ **(b)** $\frac{1}{3}$ **(c)** $\frac{1}{2}$ **(d) 0**

**Solution:**

**(a)** When a die-is thrown,then total number of outcomes = 6 Odd number less than 3

is 1 only.
Number of possible outcomes = 1
Required probability = $\frac{1}{6}$

**Question 21:**
**A card is drawn from a deck of 52 cards. The event E is that card is not an ace of hearts. The number of outcomes favourable to E is**
**(a) 4 (b) 13 (c) 48 (d) 51**
**Solution:**
**(d)** In a deck of 52 cards, there are 13 cards of heart and 1 is ace of heart.
Hence, the number of outcomes favourable to E = 51

**Question 22:**
**The probability of getting a bad egg in a lot of 400 is 0.035. The number of bad eggs in the lot is**
**(a) 7 (b) 14 (c) 21 (d) 28**
**Solution:**
**(b)** Here, total number of eggs = 400
Probability of getting a bad egg = 0.035
Or, $\frac{number\ of\ bad\ eggs}{total\ \ number\ of\ eggs} = 0.035$

or, $\frac{number\ of\ bad\ eggs}{400}$ = 0.035

Number of bad eggs = 0.035(400) = 14

**Question 23:**
**A girl calculates that the probability of her winning the first prize in a lottery is 0.08. If 6000 tickets are sold, then how many tickets has she bought?**
**(a) 40 (b) 240 (c) 480 (d) 750**
**Solution:**
(c) Given, total number of sold tickets = 6000
Let she bought x tickets.
Then, probability of her winning the first prize = $\frac{x}{6000}$ = 0.08
or, x = 0.08(6000) = 480
Hence, she bought 480 tickets.

**Question 24:**
**One ticket is drawn at random from a bag containing tickets numbered 1 to 40. The probability that the selected ticket has a number which is a multiple of 5 is**
**(a) $\frac{1}{5}$ (b) $\frac{3}{5}$ (c) $\frac{4}{5}$ (d) $\frac{1}{3}$**
**Solution:**
**(a)** Number of total outcomes = 40
Multiples of 5 between 1 to 40 = 5,10,15,20,25. 30 35, 40

Total number of possible outcomes = 8
required probability = $\frac{8}{40} = \frac{1}{5}$

**Question 25:**
**Someone is asked to take a number from 1 to 100. The probability that it is a prime,is**
**(a)** $\frac{1}{5}$ **(b)** $\frac{6}{25}$ **(c)** $\frac{1}{4}$ **(d)** $\frac{13}{50}$
**Solution:**
**(c)** Total numbers of outcomes = 100
So, the prime numbers between 1 to 100 are 2, 3, 5, 7,11,13,17,19, 23, 29, 31,37, 41. 43, 47, 53, 56, 61, 67, 71, 73, 79, 83, 89 and 97.
Total no. of possible outcomes = 25
required probability = $\frac{25}{100} = \frac{1}{4}$

**Question 26:**
**A school has five houses A, B, C, D and E. A class has 23 students, 4 from house A, 8 from house B, 5 from house C, 2 from house D and rest from house E. A single student is selected at random to be the class monitor. The probability that the selected student is not from A, B and C is**
**(a)** $\frac{4}{23}$ **(b)** $\frac{6}{23}$ **(c)** $\frac{8}{23}$ **(d)** $\frac{17}{23}$
**Solution:**
**(b)** Total number of students = 23
Number of students in house A, B and C = 4+ 8 + 5 = 17
Remaining students = 23 – 17 = 6
So probability that the selected student is not from A, B, and C = $\frac{6}{23}$

## Exercise 13.2

**Question 1: The median of an ungrouped data and the median calculated when the same data is grouped are always the same. Do you think that this is a correct statement? Give reason.**
**Solution:**
Not always, because for calculating median of a grouped data, the formula used is based on the assumption that the observations in the classes are uniformal distributed (or equally spaced).

**Question 2:**
**In calculating the mean of grouped data, grouped in classes of equal width, we may use the formula,**

$$\bar{x} = a + \frac{\Sigma f_i d_i}{\Sigma f_i}$$

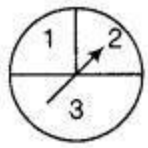
**Where, a is the assumed mean, a must be one of the mid-point of the classes. Is the last statement correct? Justify your answer.**
**Solution:**
No, it is not necessary that assumed mean consider as the mid-point of the class interval. It is considered as any value which is easy to simplify it.

**Question 3:**
**Is it true to say that the mean, mode and median of grouped data will always be different? Justify your answer**
**Solution:** The value of these three measures can be the same, it depends on the type of data.

**Question 4:**
**Will the median class and modal class of grouped data always be different? Justify your answer.**
**Solution:**
Not always, It depends on the given data.

**Question 5:**
**In a family having three children, there may be no girl, one girl, two girls or three girls. So, the probability of each is $\frac{1}{4}$ . Is this correct? Justify your answer.**
**Solution:**
No, the probability of each is not $\frac{1}{4}$ because the probability of no girl in three children is zero and probability of three girls in three children is one.
**Justification**
So, these events are not equally likely as outcome one girl, means gbb, bgb, bbg 'three girls' means 'ggg' and so on.

**Question 6:**
**A game consists of spinning an arrow which comes to rest pointing at one of the regions (1, 2 or 3) (see figure). Are the outcomes 1, 2 and 3 equally likely to occur? Give reasons**




**Solution:**
No, the outcomes are not equally likely, because 3 contains half part of the total region, so it is more likely than 1 and 2, since 1 and 2, each contains half part of the remaining part of the region.

**Question 7: Apoorv throws two dice once and computes the product of the numbers appearing on the dice. Peehu throws one die and squares the number that appears on it. Who has the better chance of getting the number 36? Why?**
**Solution:**

Apoorv throws two dice once.
So total number of outcomes = 36
Number of outcomes for getting product 36 = 1 (6 x 6)
Probability for Apoorv = $\frac{1}{36}$
Also, Peehu throws one die,
So, total no. of outcomes = 6
No. of outcomes for getting square 36 = 1($6^2$ = 36)
Probability for Peehu = $\frac{1}{6} = \frac{6}{36}$

Hence, Peehu has better chance of getting the number 36.

**Question 8:**
**When we toss a coin, there are two possible outcomes-head or tail. Therefore, the probability of each outcome is $\frac{1}{2}$. Justify your answer**
**Solution:**
Yes, probability of each outcome is $\frac{1}{2}$ because head and tail both are equally likely events.

**Question 9:**
**A student says that, if you throw a die, it will show up 1 or not 1. Therefore, the probability of getting 1 and the probability of getting not 1. each is equal to $\frac{1}{2}$. Is this correct? Give reasons.**
**Solution:**
No, this is not correct.
Suppose we throw a die, then total number of outcomes = 6
Possible outcomes = 1 or 2 or 3 or 4 or 5 or 6

Probability of getting 1 = $\frac{1}{6}$
Now, probability of getting not 1 = 1 – probability of getting 1 = 1 - $\frac{1}{6} = \frac{5}{6}$

**Question 10:**
**I toss three coins together. The possible outcomes are no heads, 1 head,2 head and 3 heads. So, I say that probability of no heads is $\frac{1}{4}$. What is wrong with this conclusion?**
**Solution:**
I toss three coins together      [given]

So, total number of outcomes = $2^3 = 8$
and possible outcomes are (HHH), (HTT), (THT), (TTH),(HHT), (THH), (HTH)and (TTT)
Now probability of getting no head = $\frac{1}{8}$
Hence, the given conclusion is wrong because the probability of no head is $\frac{1}{8}$ not $\frac{1}{4}$

**Question 11:**
**If you toss a coin 6 times and it comes down heads on each occasion. Can you say that the probability of getting a head is 1? Given reasons**.
**Solution:**
No. if let we toss a coin, then we get head or tail, both are equally likely events
So,probability is $\frac{1}{2}$. If we toss a coin 6 times, then probability will be same in each case. So, the probability of getting a head is not 1.

**Question 12:**
**Sushma tosses a coin 3 times and gets tail each time. Do you think that the outcome of next toss will be a tail? Give reasons.**
**Solution:**
The outcome of next toss may or may not be tail, because on tossing a coin, we get head or tail so both are equally likely events.

**Question 13:**
I**f I toss a coin 3 times and get head each time, should I expect a tail to have a higher chance in the 4th toss? Give reason in support of your answer.**
**Solution:**
No, let we toss a coin, then we get head or tail, both are equally likely events i.e., probability of each event is $\frac{1}{2}$. So, no question of expecting a tail to have a higher chance in 4th toss.

**Question 14:**
**A bag contains slips numbered from 1 to 100. If Fatima chooses a slip at random from the bag, it will either be an odd number or an even number. Since, this situation has only two possible outcomes, so the 1 probability of each is $\frac{1}{2}$. Justify.**
**Solution:**
We know that, between 1 to 100 half numbers are even and half numbers are odd i.e., 50 numbers (2, 4, 6, 8…. 96, 98,100) are even and 50 numbers (1,3, 5, 7. . , 97, 99) are odd.
So, both events are equally likely.
So, probability of getting even no = $\frac{50}{100} = \frac{1}{2}$
and probability of getting odd no. = $\frac{50}{100} = \frac{1}{2}$
Hence, the probability of each is $\frac{1}{2}$

# Exercise 13.3

**Question 1:**
**Find the mean of the distribution**

| Class | 1-3 | 3-5 | 5-7 | 7-10 |
|---|---|---|---|---|
| Frequency | 9 | 22 | 27 | 17 |

**Solution:**
We first, find the class mark $x_{i,}$ of each class and then proceed as follows.

| Class | Class marks ($x_i$) | Frequency ($f_i$) | $f_i x_i$ |
|---|---|---|---|
| 1 – 3 | 2 | 9 | 18 |
| 3 – 5 | 4 | 22 | 88 |
| 5 – 7 | 6 | 27 | 162 |
| 7 – 10 | 8.5 | 17 | 144.5 |

Therefore, mean ($\bar{x}$) = $\frac{\sum f_i x_i}{\sum x_i}$ = $\frac{412.5}{75}$ $= 5.5$ Hence, mean of the given distribution is 5.5.

**Question 2:**
**Calculate the mean of the scores of 20 students in a mathematics test**

| Marks | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 |
|---|---|---|---|---|---|
| Number of students | 2 | 4 | 7 | 6 | 1 |

**Solution:**
We first, find the class mark of each class and then proceed as follows

| Marks | Class marks ($x_i$) | Frequency ($f_i$) | $f_i x_i$ |
|---|---|---|---|
| 10 – 20 | 15 | 2 | 30 |
| 20 – 30 | 25 | 4 | 100 |

| | | | |
|---|---|---|---|
| 30 – 40 | 35 | 7 | 245 |
| 40 – 50 | 45 | 6 | 270 |
| 50 – 60 | 55 | 1 | 55 |

Therefore, mean ($\bar{x}$) = $\frac{\sum f_i x_i}{\sum x_i}$ = $\frac{700}{20} = 35$
Hence, the mean of scores of 20 students in mathematics test is 35.

**Question 3:**
**Calculate the mean of the following data**

| **Class** | 4-7 | 8-11 | 12-15 | 16-19 |
|---|---|---|---|---|
| **Frequency** | 5 | 4 | 9 | 10 |

**Solution:**
Since, given data is not continuous, so we subtract 0.5 from the lower limit and add 0.5 in the upper limit of each class.
Now, we first find the class mark $x_i$, of each class and then proceed as follows

| Marks | Class marks ($x_i$) | Frequency ($f_i$) | $f_i x_i$ |
|---|---|---|---|
| 3.5 – 7.5 | 5.5 | 5 | 27.5 |
| 7.5 – 11.5 | 9.5 | 4 | 38 |
| 30 – 40 | 13.5 | 9 | 121.5 |
| 40 – 50 | 17.5 | 10 | 175 |

therefore, mean ($\bar{x}$) = $\frac{\sum f_i x_i}{\sum x_i}$ = $\frac{362}{28} = 12.93$
Hence, mean of the given data is 12.93.

**Question 4:**
**The following table gives the number of pages written by Sarika for completing her own book for 30 days.**

| No. of pages written per day | 16 – 18 | 19 – 21 | 22 – 24 | 25 – 27 | 28 – 30 |
|---|---|---|---|---|---|
| No. of boys | 1 | 3 | 4 | 9 | 13 |

**Find the mean number of pages written per day.**
**Solution:**
Since,

| Class Mark | Mid-value ($x_i$) | No. of days ($f_i$) | $f_i x_i$ |
|---|---|---|---|
| 15.5 – 18.5 | 17 | 1 | 17 |
| 18.5 – 21.5 | 20 | 3 | 60 |
| 21.5 – 24.5 | 23 | 4 | 92 |
| 24.5 – 27.5 | 26 | 9 | 234 |
| 27.5 – 30.5 | 29 | 13 | 377 |
| Total | | 30 | 780 |

Since, given data is not continuous, so we subtract 0.5 from the lower limit and add 0.5 in the upper limit of each class.
Thus, mean ($\bar{x}$) = $\frac{\sum f_i x_i}{\sum x_i} = \frac{780}{30} = 26$
Hence, the mean of pages written per day is 26.

**Question 5:**
**The daily income of a sample of 50 employees are tabulated as follows.**

| Income (in ₹) | 1-200 | 201-400 | 401-600 | 601-800 |
|---|---|---|---|---|
| Number of employees | 14 | 15 | 14 | 7 |

**Find the mean daily income of employees.**
**Solution:**
Since, given data is not continuous, so we subtract 0.5 from the lower limit and add

0.5 in the upper limit of each class.
Now we first, find the class mark $x_i$, of each class and then proceed as follows:

| Income | Class marks($x_i$) | No. of employees ($f_i$) | $u_i = \frac{x_i - a}{h} = \frac{x_i - 300.5}{200}$ | $f_i u_i$ |
|---|---|---|---|---|
| 0.5 – 200.5 | 100.5 | 14 | -1 | -14 |
| 200.5 – 400.5 | a = 300.5 | 15 | 0 | 0 |
| 400.5 – 600.5 | 500.5 | 14 | 1 | 14 |
| 600.5 – 800.5 | 700.5 | 7 | 2 | 14 |
| | | $N = \sum f_i = 50$ | | $\sum f_i u_i = 14$ |

Assumed mean, a = 300.5
Class width h = 200
total observations N = 50
by step deviation method, Mean = a + h $\frac{1}{N} \times \sum_{i=1}^{5} f_i u_i$

$$= 300.5 + 200 \times \frac{1}{5} \times 14$$
$$= 300.5 + 56 = 356.5$$

**Question 6:**
**An aircraft has 120 passenger seats. The number of seats occupied during 100 flights is given in the following table.**

| Number of seats | 100-104 | 104-108 | 108-112 | 112-116 | 116-120 |
|---|---|---|---|---|---|
| Frequency | 15 | 20 | 32 | 18 | 15 |

**Determine the mean number of seats occupied over the flights.**
**Solution:**

We first, find the class mark $x_i$, of each class and then proceed as follows.

| No. of seats | Class marks($x_i$) | Frequency ($f_i$) | Deviation $d_i = x_i - a$ | $f_i d_i$ |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 100 – 104 | 102 | 15 | -8 | -120 |
| 104 – 108 | 106 | 20 | -4 | -80 |
| 108 – 112 | a = 110 | 32 | 0 | 0 |
| 112 – 116 | 114 | 18 | 4 | 72 |
| 116 – 120 | 118 | 15 | 8 | 120 |
| | | N = $\sum f_i = 100$ | | $\sum f_i \, d_i$ = -8 |

Assumed mean, a = 110
Class width, h = 4
total observation N = 100
By assumed method, mean ($\bar{x}$) = a + $\frac{\sum f_i d_i}{\sum f_i}$ = $110 + \left(\frac{-8}{100}\right) = 110 - 0.08 = 109.92$

**Question 7: The weights (in kg) of 50 wrestlers are recorded in the following table.**
**Find the mean weight of the wrestlers.**

| **Weight** (in kg) | 100-110 | 110-120 | 120-130 | 130-140 | 140-150 |
|---|---|---|---|---|---|
| **Number of wrestlers** | 4 | 14 | 21 | 8 | 3 |

**Solution:**

We first find the class mark of each class and then proceed as follows:

| Weight in kg | No. of wrestlers($f_i$) | Class marks ($x_i$) | Deviation $d_i = x_i - a$ | $f_i d_i$ |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 100 – 110 | 4 | 105 | -20 | -80 |
| 110 – 120 | 14 | 115 | -10 | 140 |
| 120 – 130 | 21 | 125 = a | 0 | 0 |
| 130 – 140 | 8 | 135 | 10 | 80 |
| 140 – 150 | 3 | 145 | 20 | 60 |
| | N = $\sum f_i = 50$ | | | $\sum f_i\, d_i$ = 80 |

Assumed mean, a = 125
Class width (h) = 10 and total observation = 50
BY assumed mean method,   mean ($\bar{x}$) = a + $\frac{\sum f_i d_i}{\sum f_i}$ = $125 + \left(\frac{-8}{50}\right) = 123.4$ kg

**Question 8:**
**The mileage (km per litre) of 50 cars of the same model was tested by a manufacturer and details are tabulated as given below**

| **Mileage** | **10 – 12** | **12 – 14** | **14 – 16** | **16 – 18** |
|---|---|---|---|---|
| **No. of cars** | **7** | **12** | **18** | **13** |

**Find the mean mileage.**
**The manufacturer claimed that the mileage of the model was 16 kmL $^{-1}$.**
**Do you agree with this claim?**
**Solution:**

| Mileage | Class marks ($x_i$) | No. of cars ($f_i$) | $f_i x_i$ |
|---|---|---|---|
| 10 – 12 | 11 | 7 | 77 |
| 12 – 14 | 13 | 12 | 156 |
| 14 – 16 | 15 | 18 | 270 |
| 16 – 18 | 17 | 13 | 221 |

| | | | |
|---|---|---|---|
| Total | | $\sum f_i = 50$ | $\sum f_i x_i$ = 724 |

Hence, mean mileage is 14.48 kmL$^{-1}$.
No, the manufacturer is claiming mileage 1.52 kmh$^{-1}$ more than average mileage.

**Question 9:**
**The following is the distribution of weights (in kg) of 40 persons.**

| **Weight** | **40 – 45** | **45 – 50** | **50 – 55** | **55 – 60** | **60 – 65** | **65 – 70** | **70 – 75** | **75 – 80** |
|---|---|---|---|---|---|---|---|---|
| **No. of persons** | **4** | **4** | **13** | **5** | **6** | **5** | **2** | **1** |

**Construct a cumulative frequency distribution (of the less than type) table for the data above.**
**Solution:**
The cumulative distribution (less than type) table is shown below

| **Weight** (in kg) | **Cumulative frequency** |
|---|---|
| Less than 45 | 4 |
| Less than 50 | 4 + 4 = 8 |
| Less than 55 | 8 + 13 = 21 |
| Less than 60 | 21 + 5 = 26 |
| Less than 65 | 26 + 6 = 32 |
| Less than 70 | 32 + 5 =37 |
| Less than 75 | 37 + 2 = 39 |
| Less than 80 | 39 + 1 = 40 |

| Weight in kg | Cumulative frequency |
|---|---|
| Less than 45 | 4 |
| Less than 50 | 4 + 4 = 8 |
| Less than 55 | 8 +13 = 21 |
| Less than 60 | 21 + 5 = 26 |

| | |
|---|---|
| Less than 65 | 26 + 6 = 32 |
| Less than 70 | 32 + 5 = 37 |
| Less than 75 | 37 + 2 = 39 |
| Less than 80 | 39 + 1 = 40 |

**Question 10:**
**The following table shows the cumulative frequency distribution of marks of 800 students in an examination.**

| Marks | Number of students |
|---|---|
| Below 10 | 10 |
| Below 20 | 50 |
| Below 30 | 130 |
| Below 40 | 270 |
| Below 50 | 440 |
| Below 60 | 570 |
| Below 70 | 670 |
| Below 80 | 740 |
| Below 90 | 780 |
| Below 100 | 800 |

**Construct a frequency distribution table for the data above.**
**Solution:**
Here, we observe that 10 students have scored marks below 10 i.e., it lies between class interval 0-10. Similarly, 50 students have scored marks below 20. So, 50 -10 = 40 students lies in the interval 10-20 and so on. The table of a frequency distribution for the given data is:

| Class interval | No. of students |
|---|---|
| 0 – 10 | 10 |

| | |
|---|---|
| 10 – 20 | 50 – 10 = 40 |
| 20 – 30 | 130 – 50 = 80 |
| 30 – 40 | 270 – 30 = 140 |
| 40 – 50 | 440 – 270 = 170 |
| 50 – 60 | 570 – 440 = 130 |
| 60 – 70 | 670 – 570 = 100 |
| 70 – 80 | 740 – 670 = 70 |
| 80 – 90 | 780 – 740 = 40 |
| 90 – 100 | 800 – 780 = 20 |

**Question 11:**
**From the frequency distribution table from the following data.**
More than or equal to 80……………4
More than or equal to 70……………6
More than or equal to 60……………11
More than or equal to 50…………..17
More than or equal to 40……………23
More than or equal to 30…………….27
More than or equal to 20…………….30
More than or equal to 10…………….32
More than or equal to 0………………..34

**Solution:**
Here, we observe that, all 34 students have scored marks more than or equal to 0. Since, 32 students have scored marks more than or equal to 10. So, 34- 32 =2 students lies in the interval 0-10 and so on.
Now, we construct the frequency distribution table.

| Class interval | No. of candidates |
|---|---|
| 0 – 10 | 34 – 32 = 2 |

| | |
|---|---|
| 10 – 20 | 32 – 30 = 2 |
| 20 – 30 | 30 – 27 = 3 |
| 30 – 40 | 27 – 23 = 4 |
| 40 – 50 | 23 – 17 = 6 |
| 50 – 60 | 17 – 11 = 6 |
| 60 – 70 | 11 – 6 = 5 |
| 70 – 80 | 6 – 4 = 2 |
| 80 – 90 | 4 |

**Question 12:**
**Find the unknown entries o, b, c, d, e and f in the following distribution of heights of students in a class**

| **Height** (in cm) | **Frequency** | **Cumulative frequency** |
|---|---|---|
| 150-155 | 12 | *a* |
| 155-160 | *b* | 25 |
| 160-165 | 10 | *c* |
| 165-170 | *d* | 43 |
| 170-175 | *e* | 48 |
| 175-180 | 2 | *f* |
| **Total** | 50 | |

**Solution:**

| Height | Frequency | Cumulative frequency | Cumulatuve frequency |
|---|---|---|---|
| 150 – 155 | 12 | a | 12 |
| 155 – 160 | b | 25 | 12 + b |
| 160 – 165 | 10 | C | 22 + b |

| | | | |
|---|---|---|---|
| 165 – 170 | d | 43 | 22 + b+ d |
| 170 – 175 | e | 48 | 22 + b + d + e |
| 175 – 180 | 2 | f | 24 + b + d + e |
| Total | 50 | | |

on comparing last two tables, we get
a = 12
12 + b = 25
b = 25 – 12 = 13

22 + b = c
c = 22 + 13 = 35
22 + b + d = 43
22 + 13 + d = 43
d = 43 – 35 = 8 and,
22 + b + d + e = 48
or, 22 + 13 + 8 + e = 48
or, e = 48 – 43 = 5
24 + b + d + e = f
24 + 13 + 8 + 5 = f
f = 50

**Question 13:**
**The following are the ages of 300 patients getting medical treatment in a hospital on a particular day**

| **Age** (in year) | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 | 60-70 |
|---|---|---|---|---|---|---|
| **Number of patients** | 60 | 42 | 55 | 70 | 53 | 20 |

**Form**
**(i) less than type cumulative frequency distribution.**
**(ii) More than type cumulative frequency distribution**.
**Solution:**
(i) We observe that the number of patients which take medical treatment in a hospital on a particular day less than 10 is O'. Similarly, less than 20 include the number of patients which take medical treatment from 0-10 as well as the number of patients which take medical treatment from 10-20.
So, the total number of patients less than 20 is 0 + 60 = 60, we say that the cumulative frequency of the class 10-20 is 60. Similarly, for other class.
(ii) Also, we observe that all 300 patients which take medical treatment more than or

equal to 10. Since, there are 60 patients which take medical treatment in the interval 10-20, this means that there are 300 – 60 = 240 patients which take medical treatment more than or equal to 20. Continuing in the same manner.

| (i) Less than type | | (ii) More than type | |
|---|---|---|---|
| Age | No. of students | Age | No of students |
| Less than 10 | 0 | More than or equal to 10 | 300 |
| Less than 20 | 60 | More than or equal to 20 | 240 |
| Less than 30 | 102 | More than or equal to 30 | 198 |
| Less than 40 | 157 | More than or equal to 40 | 143 |
| Less than 50 | 227 | More than or equal to 50 | 73 |
| Less than 60 | 280 | More than or equal to 60 | 60 |
| Less than 70 | 300 | | |

**Question 14:**
**Given below is a cumulative frequency distribution showing the marks secured by 50 students of a class**

| Marks | Below 20 | Below 40 | Below 60 | Below 80 | Below 100 |
|---|---|---|---|---|---|
| Number of students | 17 | 22 | 29 | 37 | 50 |

**Form the frequency distribution table for the data.**
**Solution:**
Here, we observe that, 17 students have scored marks below 20 i.e., it lies between class interval 0-20 and 22 students have scored marks below 40, so 22 -17 = 5 students lies in the class interval 20-40 continuing in the same manner, we get the complete frequency distribution table for given data.

| Marks | No. of students |
|---|---|
| 0 – 20 | 17 |
| 20 – 40 | 22 – 17 = 5 |
| 40 – 60 | 29 – 22 = 7 |
| 60 – 80 | 37 – 29 = 8 |
| 80 – 100 | 50 – 37 = 13 |

**Question 15:**
**Weekly income of 600 families is tabulated below**

| Weekly income (in ₹) | Number of families |
|---|---|
| 0-1000 | 250 |
| 1000-2000 | 190 |
| 2000-3000 | 100 |
| 3000-4000 | 40 |
| 4000-5000 | 15 |
| 5000-6000 | 5 |
| **Total** | **600** |

**Compute the median income.**
**Solution:**
First we construct a cumulative frequency table

| Weekly income (in ₹) | Number of families ($f_i$) | Cumulative frequency ($cf$) |
|---|---|---|
| 0-1000 | 250 | 250 |
| 1000-2000 = mid class | $190 = f$ | $250 + 190 = 440$ |
| 2000-3000 | 100 | $440 + 100 = 540$ |
| 3000-4000 | 40 | $540 + 40 = 580$ |
| 4000-5000 | 15 | $580 + 15 = 595$ |
| 5000-6000 | 5 | $595 + 5 = 600$ |

It is given that, $n = 600$

$\therefore$ $$\frac{n}{2} = \frac{600}{2} = 300$$

Since, cumulative frequency 440 lies in the interval 1000 - 2000.

Here, (lower median class) $l = 1000$,

$f = 190, cf = 250$, (class width) $h = 1000$

and (total observation) $n = 600$

$\therefore$ $$\text{Median} = l + \frac{\left\{\frac{n}{2} - cf\right\}}{f} \times h$$

$$= 1000 + \frac{(300 - 250)}{190} \times 1000$$

$$= 1000 + \frac{50}{190} \times 1000$$

$$= 1000 + \frac{5000}{19}$$

$$= 1000 + 263.15 = 1263.15$$

Hence, the median income is ₹ 1263.15.

**Question 16:**

**The maximum bowling speeds, in km per hour, of 33 players at a cricket coaching centre are given as follows**

| **Speed** (in km/h) | 85-100 | 100-115 | 115-130 | 130-145 |
|---|---|---|---|---|
| **Number of players** | 11 | 9 | 8 | 5 |

**Caluculate the median bowling speed.**

**Solution:**

First we construct the cumulative frequency table

| Speed (in km/h) | Number of players | Cumulative frequency |
|---|---|---|
| 85-100 | 11 | 11 |
| 100-115 | 9 | $11+9=20$ |
| 115-130 | 8 | $20+8=28$ |
| 130-145 | 5 | $28+5=33$ |

It is given that, $n = 33$

$$\therefore \quad \frac{n}{2} = \frac{33}{2} = 16.5$$

So, the median class is 100-115.

where, lower limit $(l) = 100$,

frequency $(f) = 9$,

cumulative frequency $(cf) = 11$

and class width $(h) = 15$

$$\therefore \quad \text{Median} = l + \frac{\left(\frac{n}{2} - cf\right)}{f} \times h$$

$$= 100 + \frac{(16.5 - 11)}{9} \times 15$$

$$= 100 + \frac{5.5 \times 15}{9} = 100 + \frac{82.5}{9} = 100 + 9.17$$

$$= 109.17$$

Hence, the median bowling speed is 109.17 km/h.

**Question 17:**

The monthly income of 100 families are given as below

| Income (in ₹) | Number of families |
|---|---|
| 0-5000 | 8 |
| 5000-10000 | 26 |
| 10000-15000 | 41 |
| 15000-20000 | 16 |
| 20000-25000 | 3 |
| 25000-30000 | 3 |
| 30000-35000 | 2 |
| 35000-40000 | 1 |

Caluculate the model income.

**Solution:**

In a given data, the highest frequency is 41, which lies in the interval 10000-15000.

Here, $l = 10000, f_m = 41, f_1 = 26, f_2 = 16$ and $h = 5000$

$$\therefore \quad \text{Mode} = l + \left(\frac{f_m - f_1}{2f_m - f_1 - f_2}\right) \times h$$
$$= 10000 + \left(\frac{41 - 26}{2 \times 41 - 26 - 16}\right) \times 5000$$
$$= 10000 + \left(\frac{15}{82 - 42}\right) \times 5000$$
$$= 10000 + \left(\frac{15}{40}\right) \times 5000$$
$$= 10000 + 15 \times 125 = 10000 + 1875 = ₹\ 11875$$

Here, $l = 10000$, $f_m = 41$, $f_1 = 26$, $f_2 = 16$ and $h = 5000$

Mode = l + $\left(\frac{f_m-f_1}{2f_m-f_1-f_2}\right) \times h$

= 10000 + $\left(\frac{41-26}{2\times41-26-16}\right) \times 5000$

= 10000 + $\left(\frac{15}{40}\right) \times 5000$ = 10000 + 1875 = 11875

Hence, the modal income is ₹ 11875.

**Question 18:**

**The weight of coffee in 70 packets are shown in the following table**

| Weight (in g) | Number of packets |
|---|---|
| 200-201 | 12 |
| 201-202 | 26 |
| 202-203 | 20 |
| 203-204 | 9 |
| 204-205 | 2 |
| 205-206 | 1 |

**Determine the model weight .**

**Solution:**

In the given data, the highest frequency is 26, which lies in the interval 201-202

Here, l = 201, $f_m = 26$, $f_1 = 12$, h = 1

Mode = l + $\left(\frac{f_m-f_1}{2f_m-f_1-f_2}\right) \times h$

= 201 + $\left(\frac{26-12}{2\times26-12-20}\right) \times 1$

= 201 + 0.7 = 201.7 g

Hence, the modal weight is 201.7 g.

**Question 19:**

**Two dice are thrown at the same time. Find the probability of getting**

**(i) same number on both dice.**

**(ii) different number on both dice.**
**Solution:**
Two dice are thrown at the same time. [given]
So, total number of possible outcomes = 36
(i) We have, same number on both dice.
So, possible outcomes are (1,1), (2, 2), (3, 3), (4, 4), (5, 5) and (6, 6).
number of possible outcomes = 6
Now, required probability = $\frac{6}{36} = \frac{1}{6}$

(ii) We have, different number on both dice.
So, number of possible outcomes
= 36 – no. of possible outcomes for same no. on both dice
= 36 – 6 = 30
Required probability = $\frac{30}{36} = \frac{5}{6}$

**Question 20:**
**Two dice are thrown simultaneously. What is the probability that the sum of the numbers appearing on the dice is**
**(i) 7 ?** **(ii) a prime number ?** **(**iii) 1 ?
**Solution:**
Two dice are thrown simultaneously. [given]
So, total number of possible outcomes = 36

(i) Sum of the no. appearing on the dice = 7
So, the possible ways are (1, 6) (2, 5) (3, 4) (4, 3) (5,2)(6,1)
No. of positive ways = 6
Required probability = $\frac{6}{36} = \frac{1}{6}$
(ii) Required probability = $\frac{15}{36} = \frac{5}{12}$
(iii) Sum of the umbers appearing on the dice is 1
it is not possible so its probability is zero

**Question 21:**
**Two dice are thrown together. Find the probability that the product of the numbers on the top of the dice is**
**(i) 6** **(ii) 12** **(iii) 7**
**Solution:**

Number of total outcomes = 36
(i) When product of the numbers on the top of the dice is 6
So, the possible ways are (1,6) (2,3) (3, 2) (6,1)
Number of possible ways = 4
required probability $=\frac{4}{36} = \frac{1}{9}$

(ii) Required probability = $\frac{4}{36} = \frac{1}{9}$

(iii) Product of the numbers on the top of the dice cannot be 7. So, its probability is zero

**Question 22:**
**Two dice are thrown at the same time and the product of numbers appearing on them is noted. Find the probability that the product is less than 9.**
**Solution:**
Number of total outcomes = 36
When product of numbers appearing on them is less than 9, then possible ways are (1,6), (1,5) (1,4), (1,3), (1,2), (1,1), (2, 2), (2, 3), (2, 4), (3, 2), (4, 2), (4,1), (3,1), (5,1), (6,1) and (2,1).
Number of possible ways = 16
Required probability $= \frac{16}{36} = \frac{4}{9}$

**Question 23:**
**Two dice are numbered 1, 2, 3, 4, 5, 6 and 1, 1, 2, 2, 3, 3, respectively. They are thrown and the sum of the numbers on them is noted. Find the probability of getting each sum from 2 to 9, separately**.
**Solution:**
Number of total outcomes = 36

(i) Let $E_1$ = event getting sum 2 = {(1,1), (1,1)}
$n(E_1) = 2$
$P(E_1) = \frac{n(E_1)}{n(S)} = \frac{2}{36} = \frac{1}{18}$

(ii) Let $E_2$ = event of getting sum 3 = {(1,2), (1,2), (2,1)(2,1)}
$P(E_2) = \frac{n(E_2)}{n(S)} = \frac{4}{36} = \frac{1}{9}$

(iii) Let $E_3$ = Event of getting sum 4 = {(2,2), (2,2), (3,1), (3,1), (1,3), (1,3)}
$P(E_3) = \frac{n(E_3)}{n(S)} = \frac{6}{36} = \frac{1}{6}$

(iv) $P(E_4) = \frac{1}{6}$
(v) $P(E_5) = \frac{1}{6}$
(vi) $P(E_6) = \frac{1}{6}$
(vii) $P(E_7) = \frac{1}{9}$
(viii) $P(E_8) = \frac{1}{18}$

**Question 24:**
**A coin is tossed two times. Find the probability of getting atmost one head.**
**Solution:**
The possible outcomes,if a coin is tossed 2 times is
S = {(HH), (HT), (TT), (TH)}
n(S) = 4
Let E = event of getting atmost one head = {(TT), (HT), (TH)}
n(E) = 3
Hence, required probability = $\frac{n(E)}{n(S)} = \frac{3}{4}$

**Question 25:**
**A coin is tossed 3 times. List the possible outcomes. Find the probability of getting**
**(i) all heads** **(ii) atleast 2 heads**
**Solution:**
The possible outcomes if a coin is tossed 3 times is
S = {(HHH), (TTT), (HTT), (THT), (TEH), (THH), (HTH), (HHT)}
(i) $P(E_1) = \frac{1}{8}$
(ii
(ii) $E_2 = \frac{4}{8} = \frac{1}{2}$

**Question 26:**
**Two dice are thrown at the same time. Determine the probability that the difference of the numbers on the two dice is 2.**
**Solution:**

The total number of sample space in two dice, n (S) = 6 x 6 = 36
Let E = Event of getting the numbers whose difference is 2
= {(1,3) (2,4) (3,5) (4,6) (3,1) (4,2) (5,3) (6,4)}
n(E) = 8
P(E) = $\frac{n(E)}{n(S)} = \frac{8}{36} = \frac{2}{9}$

**Question 27:**
**A bag contains 10 red, 5 blue and 7 green balls. A ball is drawn at random. Find the probability of this ball being a**
**(i) red ball (ii) green ball (iii) not a blue ball**
**solution:**
if a ball is drawn out of 22 balls (5 blue + 7 green + 10 red), then the total number of outcomes are,
n(S) = 22
(i) let $E_1$ = Event of getting a red ball n($E_1$) = 10
required probability = $\frac{n(E_1)}{n(S)} = \frac{10}{22} = \frac{5}{11}$

(ii) Let $E_2$ = Event of getting a green ball,
required probability = $\frac{7}{22}$

(iii) Let $E_3$ = Event getting a red ball or a green ball i.e., not a blue ball.
required probability = $\frac{17}{22}$

**Question 28:**
**The king, queen and jack of clubs are removed from a deck of 52 playing cards and then well shuffled. Now, one card is drawn at fandom from the remaining cards. Determine the probability that the card is**
**(i) a heart (ii) a king**
**Solution:**
If we remove one king, one queen and one jack of clubs from 52 cards, then the remaining
cards left, n(S) = 49

(i) Let $E_1$ = Event of getting a heart
P($E_1$) = $\frac{13}{49}$

(ii) Let $E_2$ = Event of getting a king
$P(E_2) = \frac{3}{49}$

**Question 29:**
**Refer to Q.28. What is the probability that the card is**
**(i) a club (ii) 10 of hearts**
**Solution:** (i) Let $E_3$ = Event of getting a club
$n(E_3) = (13 - 3) = 10$
Required probability = $\frac{10}{49}$

(ii) Let $E_4$ = Event of getting 10 of hearts
$n(E_4) = 1$
required probability = $\frac{1}{49}$

**Question 30:**
**All the jacks, queensapd kings are removed from a deck of 52 playing cards. The remaining cards are well shuffled and then one card is drawn at random. Giving ace a value 1 similar value for other cards, find the probability that the card has a value.**
**(i) 7 (ii) greater than 7 (iii) Less than** 7
**Solution:**
In out of 52 playing cards, 4 jacks, 4 queens and 4 kings are removed, then the remaining
cards are left, n(S) = 52 – 3 x 4 = 40.

**(i)** Let $E_1$ = Event of getting a card whose value is 7
$E$ = Card value 7 may be of a spade, a diamond, a club or a heart

$\therefore \quad n(E_1) = 4$

$\therefore \quad P(E_1) = \frac{n(E_1)}{n(S)} = \frac{4}{40} = \frac{1}{10}$

**(ii)** Let $E_2$ = Event of getting a card whose value is greater than 7
= Event of getting a card whose value is 8, 9 or 10

$\therefore \quad n(E_2) = 3 \times 4 = 12$

$P(E_2) = \frac{n(E_2)}{n(S)} = \frac{12}{40} = \frac{3}{10}$

**(iii)** Let $E$ = Event of getting a card whose value is less than 7
= Event of getting a card whose value is 1, 2, 3, 4, 5 or 6

$\therefore \quad n(E_3) = 6 \times 4 = 24$

$\therefore \quad P(E_3) = \frac{n(E_3)}{n(S)} = \frac{24}{40} = \frac{3}{5}$

**Question 31:**
**An integer is chosen between 0 and 100. What is the probability that it is**
**(i) divisible by 7? (ii) not divisible by 7?**
**Solution:**
The number of integers between 0 and 100 is
n(S)= 99

**(i)** Let $E_1$ = Event of choosing an integer which is divisible by 7
= Event of choosing an integer which is multiple of 7
= {7, 14, 21, 28, 35, 42, 49, 56, 63, 70, 77, 84, 91, 98}

$\therefore \quad n(E_1) = 14$

$\therefore \quad P(E_1) = \frac{n(E_1)}{n(S)} = \frac{14}{99}$

**(ii)** Let $E_2$ = Event of choosing an integer which is not divisible by 7

$\therefore \quad n(E_2) = n(S) - n(E_1)$
$= 99 - 14 = 85$

$\therefore \quad P(E_2) = \frac{n(E_2)}{n(S)} = \frac{85}{99}$

Question 32:
**Cards with numbers 2 to 101 are placed in a box. A card is selected at random. Find the probability that the card has**
**(i) an even number (ii) a square number**
**Solution:**
Total number of out comes with numbers 2 to 101, n(s) =100

**(i)** Let $E_1$ = Event of selecting a card which is an even number = {2, 4, 6,...100}
[in an AP, $l = a + (n-1)d$, here $l = 100$, $a = 2$ and $d = 2 \Rightarrow 100 = 2 + (n-1)2$
$\Rightarrow (n-1) = 49 \Rightarrow n = 50$]

$\therefore \quad n(E_1) = 50$

$\therefore \quad$ Required probability $= \frac{n(E_1)}{n(S)} = \frac{50}{100} = \frac{1}{2}$

**(ii)** Let $E_2$ = Event of selecting a card which is a square number
={4, 9, 16, 25, 36, 49, 64, 81, 100}
$= \{(2)^2, (3)^2, (4)^2, (5)^2, (6)^2, (7)^2, (8)^2, (9)^2, (10)^2\}$

$\therefore \quad n(E_2) = 9$

Hence, required probability $= \frac{n(E_2)}{n(S)} = \frac{9}{100}$

Question 33:
A letter of english alphabets is chosen at random. Determine the probability that the letter is a consonant
Solution:
We know that, in english alphabets, there are (5 vowels + 21 consonants)=26 letters. So, total number of outcomes in english alphabets
are,

n(S) = 26

Let $E$ = Event of choosing a english alphabet, which is a consonent
$= \{b, c, d, f, g, h, j, k, l, m, n, p, q, r, s, t, v, w, x, y, z\}$

$\therefore$ $n(E) = 21$

Hence, required probability $= \frac{n(E)}{n(S)} = \frac{21}{26}$

Question 34:

**There are 1000 sealed envelopes in a box, 10 of them contain a cash prize of ₹ 100 each, 100 of them contain a cash prize of ₹ 50 each and 200 of them contain a cash prize of ₹ 10 each and rest do not contain any cash prize. If they are well shuffled and an envelope is picked up out, what is the probability that it contains no cash prize?**

**Solution:**

Total number of sealed envelopes in a box, n (S) = 1000

Number of envelopes containing cash prize = 10 + 100 + 200 = 310

Number of envelopes containing no cash prize,

n(E) = 1000 – 310 = 690

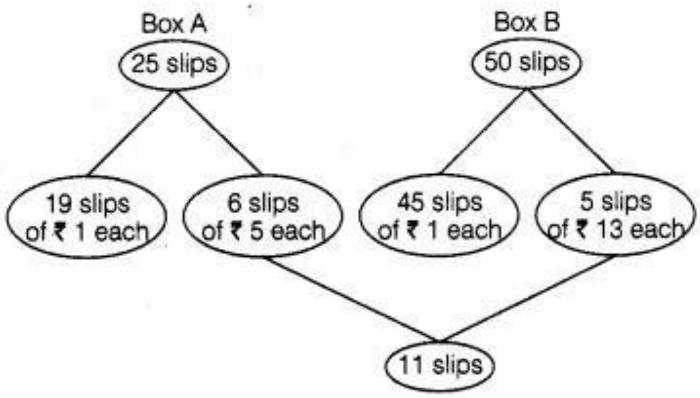
P(E) = $\frac{690}{1000} = 0.69$

Question 35:

**Box A contains 25 slips of which 19 are marked ₹ 1 and other are marked ₹ 5 each. Box B contains 50 slips of which 45 are marked ₹ 1 each and others are marked ₹ 13 each. Slips of both boxes are poured into a third box and resuffled. A slip is drawn at random. What is the probability that it is marked other than ₹ 1?**

**Solution:**

Total number of slips in a box, n(S) = 25 + 50 = 75




From the chart it is clear that, there are 11 slips which are marked other than Rs. 1

Required probability = $\frac{no. of\ slips\ other\ than\ rs\ 1}{total\ no. of\ slips} = \frac{11}{75}$

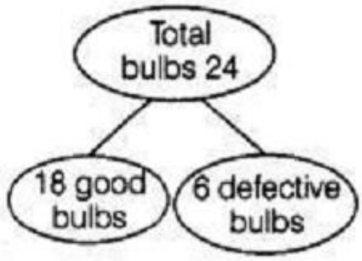
Question 36:

**A carton of 24 bulbs contain 6 defective bulbs. One bulb is drawn at random. What is the probability that the bulb is not defective? If the bulb selected is defective and it is not replaced and a second bulb is selected at random from the rest, what is the probability that the second bulb is defective?**

**Solution:**

∴Total number of bulbs, n (S) = 24

Let $E_1$ = event of selecting defective bulb = event of selecting good bulbs




$n(E_1) = 18$

$P(E_1) = \frac{18}{24} = \frac{3}{4}$

Suppose the selected bulb is defective and not replaced then total no. of bulbs remaining in a carton n (S) = 23

In them 18 are good bulbs and 5 are defective bulbs

P(selecting second defective bulb) = $\frac{5}{23}$

Question 37:

**A child's game has 8 triangles of which 3 are blue and rest are red, and 10 squares of which 6 are blue and rest are red. One piece is lost at random. Find the probability that it is a**

**(i) triangle (ii) square (iii)square of blue colour (iv) triangle of red colour**

Solution:

Total number of figures

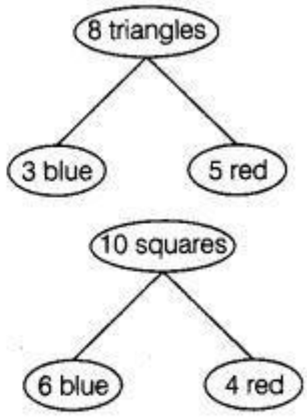
$$n(S) = 8 \text{ triangles} + 10 \text{ squares} = 18$$

**(i)** $P$ (lost piece is a triangle) $= \frac{8}{18} = \frac{4}{9}$

**(ii)** $P$ (lost piece is a square) $= \frac{10}{18} = \frac{5}{9}$

**(iii)** $P$ (square of blue colour) $= \frac{6}{18} = \frac{1}{3}$

**(iv)** $P$ (triangle of red colour) $= \frac{5}{18}$




**Question 38:**

**In a game, the entry fee is of ₹ 5. The game consists of a tossing a coin 3 times. If one or two heads show, Sweta gets her entry fee back. If she throws 3 heads, she receives double the entry fees. Otherwise she will lose. For tossing a coin three times, find the probability that she**

**(i) loses the entry fee.**

**(ii) gets double entry fee.**

**(iii) just gets her entry fee.**

Solution:

Total possible outcomes of tossing a coin 3 times,
S = {(HHH), (TTT), (HTT), (THT), (TTH), (THH), (HTH), (HHT)}
$\therefore$ n (S) = 8

**(i)** Let $E_1$ = Event that Sweta losses the entry fee
= She tosses tail on three times

$n(E_1) = \{(TTT)\}$

$P(E_1) = \frac{n(E_1)}{n(S)} = \frac{1}{8}$

**(ii)** Let $E_2$ = Event that Sweta gets double entry fee
= She tosses heads on three times = {(HHH)}

$n(E_2) = 1$

$\therefore \quad P(E_2) = \frac{n(E_2)}{n(S)} = \frac{1}{8}$

**(iii)** Let $E_3$ = Event that Sweta gets her entry fee back
= Sweta gets heads one or two times
= {(HTT), (THT), (TTH), (HHT), (HTH), (THH)}

$\therefore \quad n(E_3) = 6$

$\therefore \quad P(E_3) = \frac{n(E_3)}{n(S)} = \frac{6}{8} = \frac{3}{4}$

**Question 39:**
**A die has its six faces marked 0, 1, 1, 1, 6, 6. Two such dice are thrown together and the total score is recorded.**
**(i) How many different scores are possible?**
**(ii) What is the probability of getting a total of 7?**
Solution:
Given, a die has its six faces marked {0,1,1,1,6, 6}
Total sample space, n(S) = $6^2$ = 36
(i) The different score which are possible are 6 scores e., 0,1,2,6,7 and12.
(ii) Let E = Event of getting a sum 7
= {(1,6),(1,6),(1,6),(1,6),(1,6),(1,6),(6,1),(6,1),(6,1),(6,1),(6,1),(6,1)}

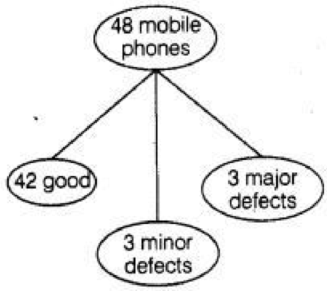
$\therefore \quad n(E) = 12$

$\therefore \quad P(E) = \frac{n(E)}{n(S)} = \frac{12}{36} = \frac{1}{3}$

**Question 40:**
**A lot consists of 48 mobile phones of which 42 are good, 3 have only minor defects and 3 have major defects. Varnika will buy a phone, if it is good but the trader will only buy a mobile, if it has no major defect. One phone is selected at random from the lot. What is the probability that it is**
**(i) acceptable to Varnika?**
**(ii) acceptable to the trader**?

Solution: Given total number of phones = n(S) = 48
(i) Let $E_1$ = event that Varnika will buy the mobile phone
$n(E_1) = 42$
$P(E_1) = \frac{42}{48} = \frac{7}{8}$

(ii) Let $E_2$ = Event that trader will buy only when it has no major defects = trader will buy only 45 mobiles
$n(E_2) = 45$
$P(E_2) = \frac{45}{48} = \frac{15}{16}$




**Question 41:**
**A bag contains 24 balls of which x are red, 2x are white and 3x am are. A ball is selected at random. What is the probability that it**
**(i) not red? (ii) white**
Solution:
Given that, A bag contains total number of balls = 24 A bag contains number of red bails = 24
A bag contains number of white balls = 2x and a bag contains number of blue balls = x
By condition, $x + 2x + 3x = 24$
$\Rightarrow \quad 6x = 24$
$\therefore \quad x = 4$
$\therefore$Number of red balls = x = 4
Number of white balls = 2x = 2 x 4 = 8
and number of blue balls = 3x = 3 x 4 = 12
So, total number of outcomes for a ball is selected at random in a bag contains 24 balls.

⇒ n(S) = 24

(i) Let $E_1$ = event of selecting a ball which is not red

$n(E_1)$ = No. of white balls + no. of blue balls = 8 + 12 = 20

required proabbilty = $\frac{20}{24} = \frac{5}{6}$

(ii) Let E = event of selecting a ball which is white

$n(E_1)$ = No. of white balls = 8

required proabbilty = $\frac{8}{24} = \frac{1}{3}$

**Question 42:**

**At a fete, cards bearing numbers 1 to 1000, one number on one card, are put in a box. Each player selects one card at random and that card is not replaced. If the selected card has a perfect square greater than 500, the player wins a prize. What is the probability that**

**(i) the first player wins a prize?**

**(ii) the second player wins a prize, if the first has won?**

**Solution:**

Given that,, at a fete, cards bearing numbers 1 to 1000 one number on one card, are put in a box. Each player selects one card at random and that card is not replaced so, the total number of outcomes are n(S) = 1000

If the selected card has a perfect square greater than 500, then player wins a prize.

(i)

**(i)** Let $E_1$ = Event first player wins a prize = Player select a card which is a perfect square greater than 500

= {529, 576, 625, 676, 729, 784, 841, 900, 961}

= $\{(23)^2, (24)^2, (25)^2, (26)^2, (27)^2, (28)^2, (29)^2, (30)^2, (31)^2\}$

∴ $n(E_1) = 9$

So, required probability = $\frac{n(E_1)}{n(S)} = \frac{9}{1000} = 0.009$

**(ii)** First, has won *i.e.*, one card is already selected, greater than 500, has a perfect square. Since, repeatition is not allowed. So, one card is removed out of 1000 cards. So, number of remaining cards is 999.

∴ Total number of remaining outcomes, $n(S') = 999$

Let $E_2$ = Event the second player wins a rize, if the first has won.

= Remaining car s has a perfect square greater than 500 are 8.

∴ $n(E_2) = 9 - 1 = 8$

So, required probability = $\frac{n(E_2)}{n(S')} = \frac{8}{999}$

## Exercise 13.4 Long Answer Type Questions

**Question 1:**

**Find the mean marks of students for the following distribution**

| Marks | Number of students |
|---|---|
| 0 and above | 80 |
| 10 and above | 77 |
| 20 and above | 72 |
| 30 and above | 65 |
| 40 and above | 55 |
| 50 and above | 43 |
| 60 and above | 28 |
| 70 and above | 16 |
| 80 and above | 10 |
| 90 and above | 8 |
| 100 and above | 0 |

**Solution:**

| Marks | Class marks ($x_i$) | Number of students (Cumulative frequency) | $f_i$ | $f_i x_i$ |
|---|---|---|---|---|
| 0-10 | 5 | 80 | 3 | 15 |
| 10-20 | 15 | 77 | 5 | 75 |
| 20-30 | 25 | 72 | 7 | 175 |
| 30-40 | 35 | 65 | 10 | 350 |
| 40-50 | 45 | 55 | 12 | 540 |
| 50-60 | 55 | 43 | 15 | 825 |
| 60-70 | 65 | 28 | 12 | 780 |
| 70-80 | 75 | 16 | 6 | 450 |
| 80-90 | 85 | 10 | 2 | 170 |
| 90-100 | 95 | 8 | 8 | 760 |
| 100-110 | 105 | 0 | 0 | 0 |
| | | | | $\Sigma f_i x_i = 4140$ |

$$\text{Mean} = \frac{\Sigma f_i x_i}{N} = \frac{4140}{80} = 51.75$$

**Question 2:**

| Marks | Number of students |
|---|---|
| Below 10 | 5 |
| Below 20 | 9 |
| Below 30 | 17 |
| Below 40 | 29 |
| Below 50 | 45 |
| Below 60 | 60 |
| Below 70 | 70 |
| Below 80 | 78 |
| Below 90 | 83 |
| Below 100 | 85 |

**Solution:**

Here, we observe that, 5 students have scored marks below 10, i.e. it lies between class interval 0-10 and 9 students have scored marks below 20,
So, (9 – 5) = 4 students lies in the class interval 10-20. Continuing in the same manner, we get the complete frequency distribution table for given data.

| Marks | Number of students ($f_i$) | Class marks ($x_i$) | $u_i = \frac{x_i - a}{h} = \frac{x_i - 45}{h}$ | $f_i u_i$ |
|---|---|---|---|---|
| 0-10 | 5 | 5 | −4 | −20 |
| 10-20 | $9-5=4$ | 15 | −3 | −12 |
| 20-30 | $17-9=8$ | 25 | −2 | −16 |
| 30-40 | $29-17=12$ | 35 | −1 | −12 |
| 40-50 | $45-29=16$ | $a=45$ | 0 | 0 |
| 50-60 | $60-45=45$ | 55 | 1 | 15 |
| 60-70 | $70-60=10$ | 65 | 2 | 20 |
| 70-80 | $78-70=8$ | 75 | 3 | 24 |
| 80-90 | $83-78=5$ | 85 | 4 | 20 |
| 90-100 | $85-83=2$ | 95 | 5 | 10 |
| | $N=\sum f_i = 85$ | | | $\sum f_i u_i = 29$ |

Here, (assumed mean) $a = 45$
and (class width) $h = 10$
By step deviation method,

$$\text{Mean } (\bar{x}) = a + \frac{\sum f_i u_i}{\sum f_i} \times h = 45 + \frac{29}{85} \times 10 = 45 + \frac{58}{17}$$
$$= 45 + 3.41 = 48.41$$

**Question 3:**
**Find the mean age of 100 residents of a town from the following data.**

| Age equal and above (in years) | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 |
|---|---|---|---|---|---|---|---|---|
| Number of persons | 100 | 90 | 75 | 50 | 25 | 15 | 5 | 0 |

Solution:
Here, we observe that, all 100 residents of a town have age equal and above 0. Since, 90 residents of a town have age equal and above 10.
So, 100 – 90 = 10 residents lies in the interval 0-10 and so on. Continue in this manner, we get frequency of all class intervals. Now, we construct the frequency distribution table.

| Class interval | Number of persons ($f_i$) | Class marks ($x_i$) | $u_i = \frac{x_i - a}{h}$ | $f_i u_i$ |
|---|---|---|---|---|
| 0-10 | $100 - 90 = 10$ | 5 | $-3$ | $-30$ |
| 10-20 | $90 - 75 = 15$ | 15 | $-2$ | $-30$ |
| 20-30 | $75 - 50 = 25$ | 25 | $-1$ | $-25$ |
| 30-40 | $50 - 25 = 25$ | $35 = a$ | 0 | 0 |
| 40-50 | $25 - 15 = 10$ | 45 | 1 | 10 |
| 50-60 | $15 - 5 = 10$ | 55 | 2 | 20 |
| 60-70 | $5 - 0 = 5$ | 65 | 3 | 15 |
| | $N = \sum f_i = 100$ | | | $\sum f_i u_i = -40$ |

Here, (assumed mean) $a = 35$
and (class width) $h = 10$
By step deviation method,

$$\text{Mean } (\bar{x}) = a + \frac{\sum f_i u_i}{\sum f_i} \times h$$

$$= 35 + \frac{(-40)}{100} \times 10$$

$$= 35 - 4 = 31.$$

< Hence, the required mean age is 31 yr.

**Question 4:**
**The weights of tea in 70 packets are shown in the following table**

| **Weight** (in g) | **Number of packets** |
|---|---|
| 200-201 | 13 |
| 201-202 | 27 |
| 202-203 | 18 |
| 203-204 | 10 |
| 204-205 | 1 |
| 205-206 | 1 |

**Find the mean weight of packets.**
Solution:
First,we find the class marks of the given data as follows,

| Weight (in g) | Number of Packets ($f_i$) | Class marks ($x_i$) | Deviation ($d_i = x_i - a$) | $f_i d_i$ |
|---|---|---|---|---|
| 200-201 | 13 | 200.5 | $-3$ | $-39$ |
| 201-202 | 27 | 201.5 | $-2$ | $-54$ |
| 202-203 | 18 | 202.5 | $-1$ | $-18$ |
| 203-204 | 10 | $a = 203.5$ | 0 | 0 |
| 204-205 | 1 | 204.5 | 1 | 1 |
| 205-206 | 1 | 205.5 | 2 | 2 |
| | $N = \sum f_i = 70$ | | | $\sum f_i d_i = -108$ |

Here, (assume mean) $a = 203.5$
and (class width) $h = 1$
By assumed mean method,

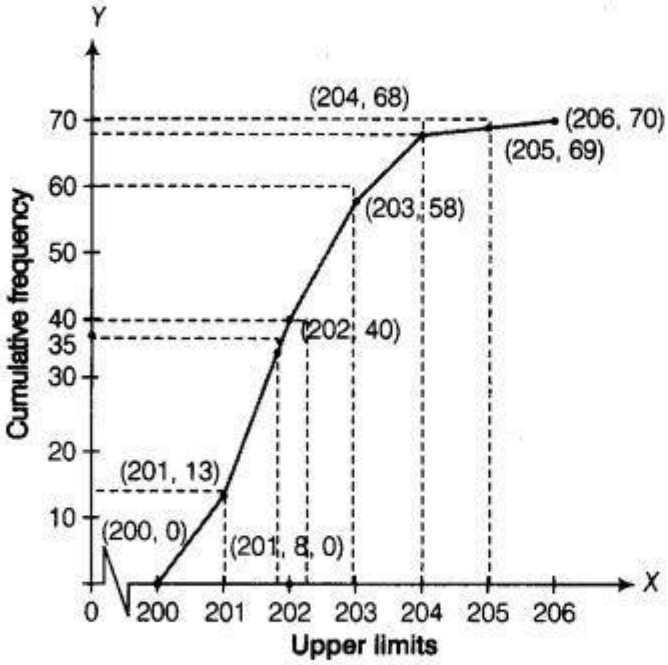
$$\text{Mean } (\bar{x}) = a + \frac{\sum f d_i}{\sum f_i}$$
$$= 203.5 - \frac{108}{70}$$
$$= 203.5 - 1.54 = 201.96$$

Hence, the required mean weight is 201.96 g.

**Question 5:**
**Refer to Q.4 above. Draw the less than type ogive for this data and use it to find the median weight.**
Solution:
We observe that the number of packets less than 200 is 0, Similarly, less than 201 include the number of packets from 0-200 as well as the number of packets from 200-201.
So, the total number of packets less than 201 is 0 + 13 = 13. We say that the cumulative frequency of the class 200-201 is 13. Similarly, for another class.

| Less than type | |
|---|---|
| **Weight (in g)** | **Number of packets** |
| Less than 200 | 0 |
| Less than 201 | $0 + 13 = 13$ |
| Less than 202 | $27 + 13 = 40$ |
| Less than 203 | $18 + 40 = 58$ |
| Less than 204 | $10 + 58 = 68$ |
| Less than 205 | $1 + 68 = 69$ |
| Less than 206 | $1 + 69 = 70$ |

To draw the less than type ogive, we plot the points (200, 0), (201, 13), (202, 40) (203, 58), (204, 68), (205, 69) and (206, 70) on the paper and join by free hand, v Total number of packets (n) = 70




Now, $\frac{N}{2} = 35$

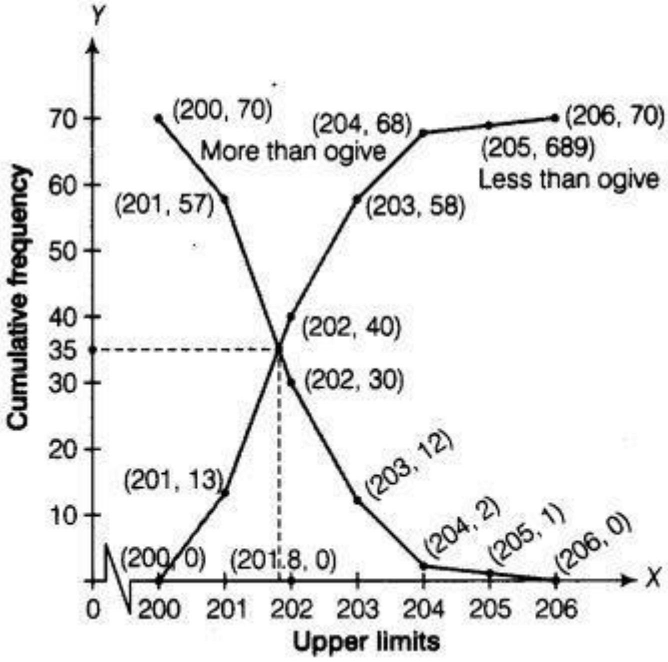
Firstly, we plot a point (0, 35) on Y-axis and draw a line y = 35 parallel to X-axis. The line cuts the less than ogive curve at a point. We draw a line on that point which is perpendicular to X-axis. The foot of the line perpendicular to the X-axis is the required median.
Median weight = 201.8 g

**Question 6:**
**Refer to Q.5 above. Draw the less than type and more than type ogives for the data and use them to find the median weight.**
Solution:
For less than type table, we follow the Q.5.
Here, we observe that the weight of all 70 packets is more than or equal to 200. Since 13 packets lie in the interval 200-201. So, the weight of 70 -13 = 57 packets is more than or equal to 201. Continuing in this manner we will get remaining more than or equal to 202, 203, 204, 205 and 206.

| (i) Less than type | | (ii) More than type | |
|---|---|---|---|
| **Weight** (in g) | **Number of packets** | **Number of packets** | **Number of students** |
| Less than 200 | 0 | More than or equal to 200 | 70 |
| Less than 201 | 13 | More than or equal to 201 | 70 − 13 = 57 |
| Less than 202 | 40 | More than or equal to 202 | 57 − 27 = 30 |
| Less than 203 | 58 | More than or equal to 203 | 30 − 18 = 12 |
| Less than 204 | 68 | More than or equal to 204 | 12 − 10 = 2 |
| Less than 205 | 69 | More than or equal to 205 | 2 − 1 = 1 |
| Less than 206 | 70 | More than or equal to 206 | 1 − 1 = 0 |

To draw the less than type ogive, we plot the points (200, 0), (201,13), (202, 40), (203, 58), (204, 68), (205,69), (206, 70) on the paper and join them by freehand.

To draw the more than type ogive plot the points (200, 70), (201, 57), (202, 30), (203, 12), (204, 2), (205,1), (206, 0) on the graph paper and join them by free hand.




Hence,required median weight = intersection point of x – axis = 201.8 g.

Question 7:

The table below shows the salaries of 280 persons.

| **Salary** (in ₹ thousand) | **Number of persons** |
|---|---|
| 5-10 | 49 |
| 10-15 | 133 |
| 15-20 | 63 |
| 20-25 | 15 |
| 25-30 | 6 |
| 30-35 | 7 |
| 35-40 | 4 |
| 40-45 | 2 |
| 45-50 | 1 |

calculate the median and mode of the data.

Solution:

First, we construct a cumulative frequency table.

| Salary (in ₹ thousand) | Number of persons ($f_i$) | Cumulative frequency ($cf$) |
|---|---|---|
| 5-10 | $49 = f_1$ | $49 = cf$ |
| 10-15 | $f_m = 133 = f$ | $133 + 49 = 182$ |
| 15-20 | $63 = f_2$ | $182 + 63 = 245$ |
| 20-25 | 15 | $245 + 15 = 260$ |
| 25-30 | 6 | $260 + 6 = 266$ |
| 30-35 | 7 | $266 + 7 = 273$ |
| 35-40 | 4 | $273 + 4 = 277$ |
| 40-45 | 2 | $277 + 2 = 279$ |
| 45-50 | 1 | $279 + 1 = 280$ |
| | $N = 280$ | |

$\therefore \quad \frac{N}{2} = \frac{280}{2} = 140$

**(i)** Here, median class is 10 – 15, because 140 lies in it.

Lower limit ($l$) = 10, Frequency ($f$) = 133,

Cumulative frequency ($cf$) = 49 and class width ($h$) = 5

$$\therefore \quad \text{Median} = l + \frac{\left(\frac{N}{2} - cf\right)}{f} \times h$$
$$= 10 + \frac{(140 - 49)}{133} \times 5$$
$$= 10 + \frac{91 \times 5}{133}$$
$$= 10 + \frac{455}{133} = 10 + 3.421$$
$$= ₹\ 13.421 \text{ (in thousand)}$$
$$= 13.421 \times 1000$$
$$= ₹\ 13421$$

**(ii)** Here, the highest frequency is 133, which lies in the interval 10-15, called modal class.

Lower limit ($l$) = 10, class width ($h$) = 5, $f_m$ = 133, $f_1$ = 49, and $f_2$ = 63.

$$\therefore \quad \text{Mode} = l + \left(\frac{f_m - f_1}{2f_m - f_1 - f_2}\right) \times h$$
$$= 10 + \left\{\frac{133 - 49}{2 \times 133 - 49 - 63}\right\} \times 5$$
$$= 10 + \frac{84 \times 5}{266 - 112} = 10 + \frac{84 \times 5}{154} = 10 + 2.727$$
$$= ₹\ 12.727 \text{ (in thousand)}$$
$$= 12.727 \times 1000 = ₹\ 12727$$

Hence, the median and modal salaries are ₹13421 and ₹12727, respectively.

Question 8:

The mean of the following frequency distribution is 50 but the frequencies $f_1$ and $f_2$ in classes 20-40 and 60-80, respectively are not known. Find these frequencies, if the sum of all the frequencies is 120.

| Class | 0-20 | 20-40 | 40-60 | 60-80 | 80-100 |
|---|---|---|---|---|---|
| Frequency | 17 | $f_1$ | 32 | $f_2$ | 19 |

Solution:

First, we calculate the class mark of given data

| Class | Frequency $(f_i)$ | Class marks $(x_i)$ | $u_i = \frac{x_i - a}{h}$ | $f_i u_i$ |
|---|---|---|---|---|
| 0-20 | 17 | 10 | $-2$ | $-34$ |
| 20-40 | $f_1$ | 30 | $-1$ | $-f_1$ |
| 40-60 | 32 | $a = 50$ | 0 | 0 |
| 60-80 | $f_2$ | 70 | 1 | $f_2$ |
| 80-100 | 19 | 90 | 2 | 38 |
| | $\Sigma f_i = 68 + f_1 + f_2$ | | | $\Sigma f_i u_i = 4 + f_2 - f_1$ |

Given that, sum of all frequencies = 120

$\Rightarrow \quad \Sigma f_i = 68 + f_1 + f_2 = 120$

$\Rightarrow \quad f_1 + f_2 = 52 \quad$ ...(i)

Here, (assumed mean) $a = 50$

and (class width) $h = 20$

By step deviation method,

$$\text{Mean} = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h$$

$$\Rightarrow \quad 50 = 50 + \frac{(4 + f_2 - f_1)}{120} \times 20$$

$\Rightarrow \quad 4 + f_2 - f_1 = 0$

$\Rightarrow \quad -f_2 + f_1 = 4 \quad$ ...(ii)

On adding Eqs. (i) and (ii), we get

$2f_1 = 56$

$\Rightarrow \quad f_1 = 28$

Put the value of $f_1$ in Eq. (i), we get

$f_2 = 52 - 28$

$\Rightarrow \quad f_2 = 24$

Hence, $f_1 = 28$ and $f_2 = 24$.

Question 9:

The median of the following data is 50. Find the values of p and q, if the sum of all the frequencies is 90.

| Marks | Frequency |
|---|---|
| 20-30 | $p$ |
| 30-40 | 15 |
| 40-50 | 25 |
| 50-60 | 20 |
| 60-70 | $q$ |
| 70-80 | 8 |
| 80-90 | 10 |

Solution

| Marks | Frequency | Cumulative frequency |
|---|---|---|
| 20-30 | $p$ | $p$ |
| 30-40 | 15 | $15+p$ |
| 40-50 | 25 | $40+p=cf$ |
| 50-60 | $20=f$ | $60+p$ |
| 60-70 | $q$ | $60+p+q$ |
| 70-80 | 8 | $68+p+q$ |
| 80-90 | 10 | $78+p+q$ |

Given, $N = 90$

$\therefore \quad \frac{N}{2} = \frac{90}{2} = 45$

which lies in the interval 50-60.

Lower limit, $l = 50, f = 20, cf = 40 + p, h = 10$

$$\therefore \quad \text{Median} = l + \frac{\left(\frac{N}{2} - cf\right)}{f} \times h$$

$$= 50 + \frac{(45 - 40 - p)}{20} \times 10$$

$$\Rightarrow \quad 50 = 50 + \left(\frac{5-p}{2}\right)$$

$$\Rightarrow \quad 0 = \frac{5-p}{2}$$

$$\therefore \quad p = 5$$

Also, $78 + p + q = 90$ [given]

$\Rightarrow \quad 78 + 5 + q = 90$

$\Rightarrow \quad q = 90 - 83$

$\therefore \quad q = 7$

Question 10:

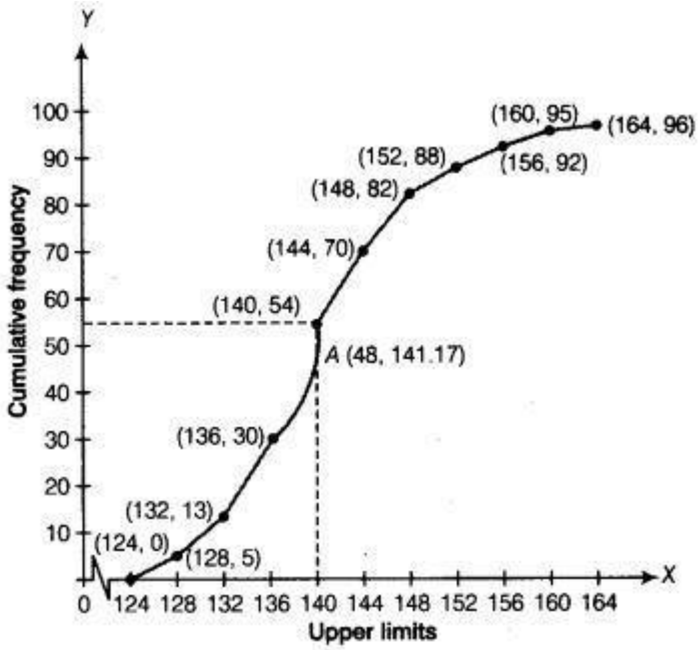
The distribution of heights (in cm) of 96 children is given below

| Height (in cm) | Number of children |
|---|---|
| 124-128 | 5 |
| 128-132 | 8 |
| 132-136 | 17 |
| 136-140 | 24 |
| 140-144 | 16 |
| 144-148 | 12 |
| 148-152 | 6 |
| 152-156 | 4 |
| 156-160 | 3 |
| 160-164 | 1 |

Draw a less than type cumulative frequency curve for this data and use it to compute the median height of the children.
Solution:

| Height (in cm) | Number of children |
|---|---|
| Less than 124 | 0 |
| Less than 128 | 5 |
| Less than 132 | 13 |
| Less than 136 | 30 |
| Less than 140 | 54 |
| Less than 144 | 70 |
| Less than 148 | 82 |
| Less than 152 | 88 |
| Less than 156 | 92 |
| Less than 160 | 95 |
| Less than 164 | 96 |

To draw the less than type ogive, we plot the points (124, 0), (128, 5), (132, 13), (136, 30), (140, 54), (144, 70), (148, 82), (152, 88), (156, 92), (160, 95), (164, 96) and join all these point by free hand.




Here, $\frac{N}{2} = \frac{96}{2}$

We take, y = 48 in Y-coordinate and draw a line parallel to X-axis, meets the curve at A and draw a perpendicular line from point A to the X-axis and this line meets the X-axis at the point which is the median i.e., median = 141.17.

Question 11:
The size of agricultural holdings in a survey of 200 families is given in the following Compute median and mode size of the holdings.

| **Size of agricultural holdings** (in hec) | **Number of families** |
|---|---|
| 0-5 | 10 |
| 5-10 | 15 |
| 10-15 | 30 |
| 15-20 | 80 |
| 20-25 | 40 |
| 25-30 | 20 |
| 30-35 | 5 |

Solution:

| Size of agricultural holdings (in hec) | Number of families ($f_i$) | Cumulative frequency |
|---|---|---|
| 0-5 | 10 | 10 |
| 5-10 | 15 | 25 |
| 10-15 | 30 | 55 |
| 15-20 | 80 | 135 |
| 20-25 | 40 | 175 |
| 25-30 | 20 | 195 |
| 30-35 | 5 | 200 |

**(i)** Here, $N = 200$

Now, $\frac{N}{2} = \frac{200}{2} = 100$, which lies in the interval 15-20.

Lower limit, $l = 15$, $h = 5$, $f = 80$ and $cf = 55$

$$\therefore \quad \text{Median} = l + \left(\frac{\frac{N}{2} - cf}{f}\right) \times h = 15 + \left(\frac{100 - 55}{80}\right) \times 5$$

$$= 15 + \left(\frac{45}{16}\right) = 15 + 2.81 = 17.81 \text{ hec}$$

**(ii)** In a given table 80 is the highest frequency.

So, the modal class is 15-20.

Here, $l = 15$, $f_m = 80$, $f_1 = 30$, $f_2 = 40$ and $h = 5$

$$\therefore \quad \text{Mode} = l + \left(\frac{f_m - f_1}{2f_m - f_1 - f_2}\right) \times h$$

$$= 15 + \left(\frac{80 - 30}{2 \times 80 - 30 - 40}\right) \times 5$$

$$= 15 + \left(\frac{50}{160 - 70}\right) \times 5$$

$$= 15 + \left(\frac{50}{90}\right) \times 5 = 15 + \frac{25}{9}$$

$$= 15 + 2.77 = 17.77 \text{ hec}$$

Question 12:

The annual rainfall record of a city for 66 days is given in the following table.

| **Rainfall** (in cm) | 0-10 | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 |
|---|---|---|---|---|---|---|
| **Number of days** | 22 | 10 | 8 | 15 | 5 | 6 |

Calculate the median rainfall using ogives (or move than type and of less than type)

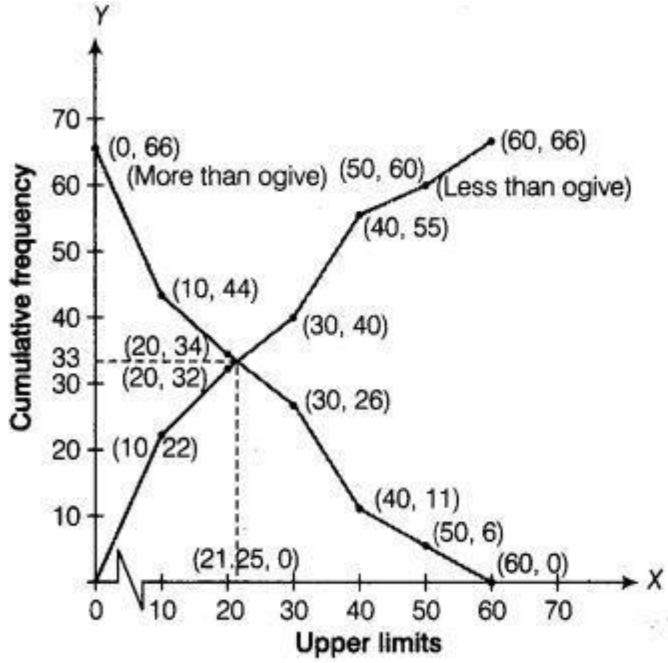
Solution:

We observe that the annual rainfall record of a city less than 0 is 0. Similarly, less than 10 include the annual rainfall record of a city from 0 as well as the annual rainfall record of a city from 0-10.v

So, the total annual rainfall record of a city for less than 10 cm is 0+ 22 =22 days. Continuing in this manner, we will get remaining less than 20, 30, 40, 50, and 60.
Also, we observe that the annual rainfall record of a city for 66 days is more than or equal to 0 cm. Since 22
days lies in the interval 0-10. So, the annual rainfall record for 66-22 = 44days is more than or equal to 10 cm.
Continuing in this manner we will get remaining more than or equal to 20, 30, 40, 50 and 60.
Now, we construct a table for less than and more than type.

| (i) **Less than type** | | (ii) **More than type** | |
|---|---|---|---|
| **Rainfall** (in cm) | **Number of days** | **Rainfall** (in cm) | **Number of days** |
| Less than 0 | 0 | More than or equal to 0 | 66 |
| Less than 10 | $0+22=22$ | More than or equal to 10 | $66-22=44$ |
| Less than 20 | $22+10=32$ | More than or equal to 20 | $44-10=34$ |
| Less than 30 | $32+8=40$ | More than or equal to 30 | $34-8=26$ |
| Less than 40 | $40+15=55$ | More than or equal to 40 | $26-15=11$ |
| Less than 50 | $55+5=60$ | More than or equal to 50 | $11-5=6$ |
| Less than 60 | $60+6=66$ | More than or equal to 60 | $6-6=0$ |

To draw less than type ogive we plot the points (0, 0), (10, 22), (20, 32), (30, 40), (40, 55), (50, 60), (60, 66) on the paper and join them by free hand.
To draw the more than type ogive we plot the points (0, 66), (10, 44), (20, 34), (30, 26), (40, 11), (50, 6) and (60, 0) on the graph paper and join them by free hand,




∵ Total number of days $(n) = 66$

Now, $\frac{n}{2} = 33$

Firstly, we plot a line parallel to X-axis at the intersection point of both ogives, which further intersect at (0, 33) on the Y-axis. Now, we draw a line perpendicular to X-axis at the intersection point of both ogives, which further intersect at (21.25, 0) on the X-axis. Which is the required median using ogives.
Hence, median rainfall = 21.25 cm.

Question 13:
The following is the frequency distribution of duration for 100 calls made on a mobile phone.

| **Duration** (in s) | **Number of calls** |
|---|---|
| 95-125 | 14 |
| 125-155 | 22 |
| 155-185 | 28 |
| 185-215 | 21 |
| 215-245 | 15 |

Solution:
First, we calculate class marks as follows

| **Duration** (in s) | **Number of calls** ($f_i$) | **Class marks** ($x_i$) | $u_i = \frac{x_i - a}{h}$ | $f_i u_i$ |
|---|---|---|---|---|
| 95-125 | 14 | 110 | −2 | −28 |
| 125-155 | 22 | 140 | −1 | −22 |
| 155-185 | 28 | $a = 170$ | 0 | 0 |
| 185-215 | 21 | 200 | 1 | 21 |
| 215-245 | 15 | 230 | 2 | 30 |
| | $\Sigma f_i = 100$ | | | $\Sigma f_i u_i = 1$ |

Here, (assumed mean) a = 170,
and (class width) h = 30
By step deviation method,

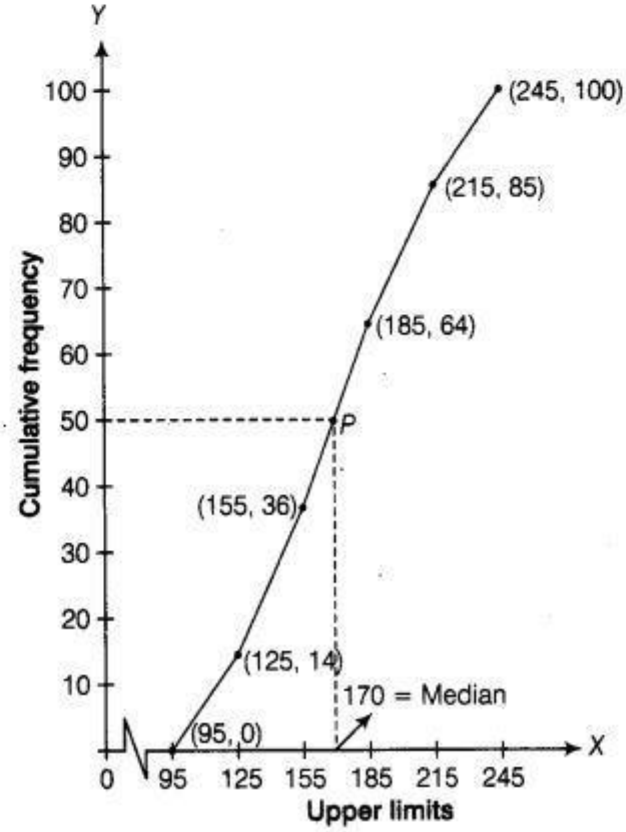
$$\text{Average } (\bar{x}) = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h = 170 + \frac{1}{100} \times 30$$

$$= 170 + 0.3 = 170.3$$

Hence, the average duration is 170.3s.
For calculating median from a cumulative frequency curve
We prepare less than type or more than type ogive
We observe that number of calls in less than 95 s is 0. Similarly, in less than 125 s include the number of calls in less than 95 s as well as the number of calls from 95-125.s So, the total number of calls less than 125 s is 0 + 14 = 14. Continuing in this manner, we will get remaining in less than 155,185, 215 and 245 s.
Now, we construct a table for less than ogive (cumulative frequency curve).

| Less than type | |
|---|---|
| **Duration** (in s) | **Number of calls** |
| Less than 95 | 0 |
| Less than 125 | 0 + 14 = 14 |
| Less than 155 | 14 + 22 = 36 |
| Less than 185 | 36 + 28 = 64 |
| Less than 215 | 64 + 21 = 85 |
| Less than 245 | 85 + 15 = 100 |

To draw less than type ogive we plot them the points (95, 0), (125, 14) (155, 36), (185, 64), (215, 85), (245, 100) on the paper and join them by free hand.




$\because$ Total number of calls ($n$) = 100

$\therefore$ $$\frac{n}{2} = \frac{100}{2} = 50.$$

Now, point 50 taking on Y-axis draw a line parallel to the X-axis meet at a point P and draw a perpendicular line from P to the X-axis, the intersection point of the X-axis is the median. Hence, the required median is 170.

**Question 14:**
**50 students enter a school javelin throw competition. The distance (in metre) thrown are recorded below**

| **Distance** (in m) | 0-20 | 20-40 | 40-60 | 60-80 | 80-100 |
|---|---|---|---|---|---|
| **Number of students** | 6 | 11 | 17 | 12 | 4 |

**(i) Construct a cumulative frequency table.**
**(ii) Draw a cumulative frequency curve (less than type) and calculate the median distance drawn by using**
**this curve.**
**(iii) Calculate the median distance by using the formula for the median.**
**(iv) Are the median distance calculated in (ii) and (iii) the same?**
**Solution:**

(i)

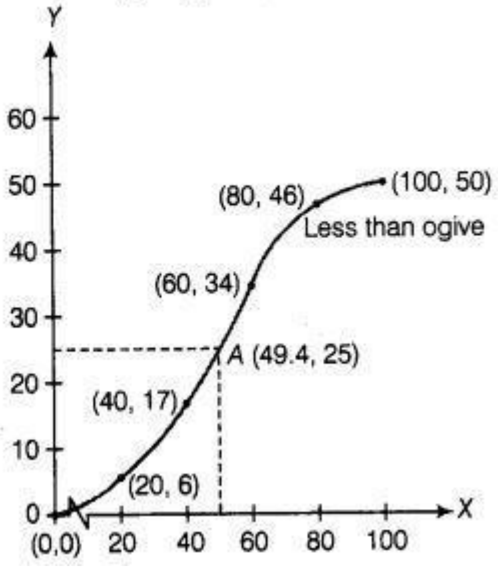
| Distance (in m) | Number of students ($f_i$) | Cumulative frequency ($cf$) |
|---|---|---|
| 0-20 | 6 | 6 |
| 20-40 | 11 | 17 |
| 40-60 | 17 | 34 |
| 60-80 | 12 | 46 |
| 80-100 | 4 | 50 |

(ii)

| Distance (in m) | Cumulative frequency |
|---|---|
| 0 | 0 |
| Less than 20 | 6 |
| Less than 40 | 17 |
| Less than 60 | 34 |
| Less than 80 | 46 |
| Less than 100 | 50 |

To draw less than type ogive, we plot the points (0, 0), (20, 6), (40,17), (60, 34), (80, 46), (100, 50), join all these points by free hand.

Now, $\frac{N}{2} = \frac{50}{2} = 25$




Taking Y = 25 on the y-axis and draw a line parallel to X-axis, which meets the curve at point

A From point A we draw a line perpendicular to X-axis, where this meets that point is the required median i.e., 49.4.

**(III)** Now, $\frac{N}{2} = \frac{50}{2} = 25$

which lies is the interval 40-60.

$\therefore$ $l = 40, h = 20, cf = 17$ and $f = 17$

$\therefore$

$$\text{Median} = l + \left(\frac{\frac{N}{2} - cf}{f}\right) \times h$$

$$= 40 + \frac{(25 - 17)}{17} \times 20$$

$$= 40 + \frac{8 \times 20}{17}$$

$$= 40 + 9.41$$

$$= 49.41$$

(lv) Yes, the median distance calculated by parts (ii) and (iii) are the same.